(54) Title: CLOSED CAPTION SYSTEM FOR USE WITH COMPRESSED DIGITAL VIDEO TRANSMISSION
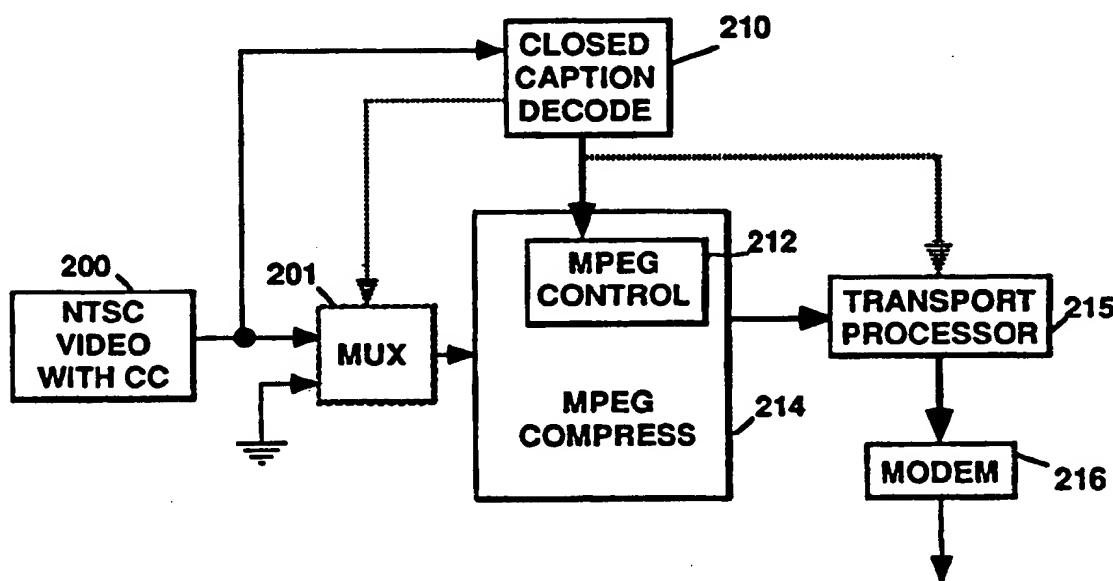
(57) Abstract

Apparatus for compressing video information including digital data in horizontal or vertical blanking intervals of analog video signals includes circuitry (210) for retrieving such digital data. The retrieved digital data is formatted into auxiliary digital data packets. The analog video signal is compressed (214) according to, for example, the MPEG compression protocol and the auxiliary digital data packets are included (212) in the compressed video signals.

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CLOSED CAPTION SYSTEM FOR USE WITH
COMPRESSED DIGITAL VIDEO TRANSMISSION

This invention relates to the transmission of closed caption and other auxiliary digital information in a compressed video
5 transmission environment.

BACKGROUND OF THE INVENTION

Current standard video signals such as PAL or NTSC include vertical intervals, or fields, having a plurality of horizontal line intervals. e.g. 262.5 lines per field in NTSC video systems. The
10 beginning of each vertical and horizontal interval is identified by respective vertical and horizontal sync pulses that are included in a composite video signal. During a portion of each vertical interval, information in the video signal may not be intended for display. For example, a vertical blanking interval spans
15 approximately the first 20 horizontal line intervals in each field. In addition, several line intervals adjacent to the vertical blanking period, e.g. line 21, may be within an overscan region of a video display and will not be visible.

The lack of displayed image information during blanking
20 and overscan intervals makes it possible to insert an auxiliary information component, e.g. teletext or closed caption data, into these intervals. Standards such as Federal Communications Commissions (FCC) Regulations define the format for each type of auxiliary information including the positioning of the information
25 within a vertical interval. For example, the present closed captioning standard (see e.g. 47 CFR   15,119 and 73.682) specifies that digital data corresponding to ASCII characters for closed captioning must be in line 21 of field 1. The FCC specified format provides for two eight-bit digital data words in each
30 occurrence of line 21, field 1. The closed caption specification may be extended to provide for closed caption format data in line 21 of every field. The data in each word represents one ASCII format character. Closed caption signal data format that complies with the FCC standard is depicted in Figure 1.
35   Recent (1993) developments in digital technologies have made practical the transmission of video signals in digital

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compressed format, allowing the transmission of more than one television signal in the same bandwidth as a conventional analog television signal. However the video compression processes tend not to be conducive to transmitting the digital codes such as the

5 closed caption information contained in the vertical blanking intervals. The present invention therefore comprises a method and apparatus for transmitting and receiving closed caption information, for example, in a compressed video transmission/storage system.

10   SUMMARY OF THE INVENTION

Apparatus for compressing video information including digital data in horizontal or vertical blanking intervals of analog video signals includes circuitry for retrieving such digital data. The retrieved digital data is formatted into auxiliary digital data

15 packets. The analog video signal is compressed according to, for example, the MPEG compression protocol and the auxiliary digital data packets are included in the frame/picture headers of the compressed video signals.

In a further embodiment including a receiver of compressed

20 video signal with auxiliary digital data packets conveying closed caption data, for example, the compressed video signal and the auxiliary digital data packets are separated. The auxiliary digital data packets are encoded into analog closed caption signal format. The compressed video signal is decompressed into standard video

25 signal format and combined with the analog closed caption signal for application to a television receiver or VCR.

                     BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an amplitude/time waveform drawing of a standard closed caption analog signal.

30   FIGURE 2 is a block diagram of a video signal compression/transmission system embodying the present invention, which system includes circuitry for transmitting closed caption-like data as digital data rather than video data

FIGURE 3 is a block diagram of apparatus for processing and

35 extracting closed caption-like data from analog television signals.

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FIGURES 4 and 5 are block diagrams of alternative receiving apparatus for receiving/reproducing compressed video signal of the form transmitted by the FIGURE 2 system.

DETAILED DESCRIPTION

5   In the description to follow, the invention will be described in terms of processing closed caption data in an NTSC video signal. However, the term "closed caption data" should be interpreted to include closed caption-like data, i.e., binary data included in an analog video signal where it will not be visible to the viewer. This

10   may be data encoded like closed caption data, for example Extended Data Services or EDS data. The encoding of EDS data follows the same general format as for caption data encoding. Closed caption data is included in line 21. If EDS data is utilized, it is transmitted in line 284. The format for respective types of data

15   consists of pairs of characters transmitted in the same field. The characters can be either a control code pair or a data pair. The first byte of the pair determines whether the pair is a control pair or a data pair. If the first byte is in the range of 01h to 0Fh, the pair is a control pair. These values are not defined for captioning

20   or text transmission. Upon receiving such a control code pair, the decoder would recognize the following data as EDS data. All characters are transmitted using odd parity. This is consistent with the current rules, and allows for simpler encoding/decoding hardware and software. In addition the invention may be

25   practiced to convey teletext data.

Referring to FIGURE 2, video signal including closed caption data on line 21 of the odd fields (or EDS data on line 284 of even fields if present) is provided from the source 200. This signal is coupled to a closed caption decoder 210 and, via a multiplexor

30   201, to a video signal compression apparatus 214, indicated as an MPEG compressor. The closed caption decoder 210 is arranged to recognize the horizontal line containing the closed caption data and to capture the closed caption data. The closed caption decoder also provides a timing signal which is used to condition the

35   multiplexor 201 to pass the active portions of video signal from the source 200, and during the horizontal line containing the

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closed caption data to couple a reference value to the compressor
214. This eliminates the digital data from the video signal and
affords a modicum of compression efficiency to the compressor
214.

5   An MPEG compressor, similar to other video signal
compressors, in general includes two basic components. The first
component operates on the video signal and performs the actual
compression of the image information signal. The second
component formats the compressed signal according to a desired
1 0 protocol. Typically the second component includes a controller
which generates header data and concatenates the header data
with the compressed video data. According to the MPEG protocol,
provision is made to include different types of user data within
the picture headers associated with respective video
1 5 frames/fields.

          In the MPEG compressor 214, a controller 212 receives the
reproduced closed caption data (without clock run-in and start
bits) from the decoder 210. The controller 212 arranges this data
as user data or extension data within the frame headers and
2 0 concatenates this data with the compressed video signal generated
in the compressor. The compressed signal including the separately
coded closed caption data in the frame or picture headers is
applied to the transport processor 215. The transport processor
215 segments the compressed video data into packets of
2 5 predetermined amounts of compressed data, generates packet
headers which identify the video information within respective
transport packets, performs error detection/correction coding and
concatenates the compressed segment, error code information and
packet header to form a transport packet. Transport packets are
3 0 coupled to a modem 216 for transmission or storage. For detailed
information on transport packet processing the reader is referred
to U.S. Patent 5,168,356.

          Table I illustrates the picture layer or frame header format
specified in the MPEG protocol. This table is reproduced from a
3 5 document, ISO-IEC/JTC1/SC29/WG11, CODED REPRESENTATION OF
PICTURE AND AUDIO INFORMATION, MPEG 92/160, Document,

5

AVC-260, May 1992 prepared under the auspices of the
INTERNATIONAL ORGANISATION FOR STANDARDISATION
operating under the procedures of The American National
Standards Institute, X3 Secretariat: Computer and Business
5 Equipment Manufacturers Association, Suite 500, 311 First Street
NW, Washington, DC 20001-2178. The code indicates provision
for both user data and extension data.

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TABLE I

PICTURE LAYER	#BITS	Mnemonic
picture () {		
picture_start_code	32	bslbf
5 temporal_reference	10	uimsbf
picture_coding_type	3	uimsbf
vbv_delay	16	uimsbf
if(picture_coding_type==2||picture_coding_type==3){		
full_pel_forward_vector	1	
10 forward_f_code	3	uimsbf
}		
if (picture coding type==3 {		
full_pel_backward_vector	1	
backward_f_code	3	uimsbf
15 }		
while (nextbits()=='1') {		
extra_bit_picture	1	"1"
extra_information_picture	8	
}		
20 extra_bit_picture	1	"0"
next_start_code()		
if(nextbits()==extension_start_code) {		
extension_start_code	32	bskbf
picture_structure	1	uimsbf
25 reserved	7	uimsbf
while(nextbits()!='0000 0000 0000 0000 0000 0001') {		
picture_extension_data	8	
}		
30 next_start_code()		
}		
if (nextbits()==user_data_start_code) {		
user_data_start_code	32	bslbf
while (nextbits()!='0000 0000 0000 0000 0000		
35 0001') {		
user_data }	8	

PICTURE LAYER   **#BITS**

```
    next_start_code()                    }
5  do {
     slice()
   } while  (nextbits()==slice_start_code)
```

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An alternative embodiment of the invention is indicated by the dashed arrow extending from the decoder 210 to the transport processor 215. In this arrangement the closed caption

5   data may be included in auxiliary transport packets or in header extensions of the transport packet headers. The format of suitable transport headers and extensions is illustrated in the U.S. Patent 5,168,356.

FIGURE 3 illustrates an exemplary closed caption decoder

1 0   apparatus which may be utilized for element 210 in FIGURE 2. In Figure 3, a composite video signal, VIDEO, which includes closed caption and/or EDS signal components, is input to a data slicer 310. The data slicer 310 converts information in the analog signal VIDEO, e.g. closed caption data, into a bilevel digital data stream

1 5   identified as the signal DIGSIG. Logic 0 and logic 1 levels in the signal DIGSIG represent levels of signal VIDEO that are less than and greater than, respectively, a slicing level maintained within data slicer 310. The slicing level is generated by data slicer 310 under control of a control unit 300 via a slicer control signal

2 0   SLCTRL. Control unit 300 may be a microprocessor.

As an example of the interaction between control unit 300 and data slicer 310, the control unit 300 may cause data slicer 310 to generate a preferred slicing level based on the amplitude of a run-in clock (RIC) signal that is included in the closed caption

2 5   signal shown in Figure 1. An example of a data slicer arrangement suitable for implementing data slicer 310 is described in pending US Patent Application Serial Number 850,481 by Rodriguez-Cavazos, et al.

The control unit 300 also monitors the signal VIDEO to

3 0   determine when a line that may contain closed caption information is present in the signal VIDEO. For example, control unit 300 may include a line counter responsive to synchronization signals (e.g. horizontal and vertical sync) in the signal VIDEO that determines when line number 21 is present. When line 21 is

3 5   detected, the control unit 21 activates data capture unit 350 via the signal CAPCTRL to extract character information included in

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line 21. Character data in line 21 occurs in the latter part of line 21 as shown in Figure 1. Thus, data extraction is initiated by control unit 300 according to the timing shown in Figure 1. Extracted data is communicated to control unit 300 via signal

5 DATA.

The control unit 300 processes the extracted data to produce the signal SYSCTRL. Signal SYSCTRL may, for example, provide closed caption data in a format suitable for display to a display device. The extended data services operation may provide for a

10 number of additional features. For example, data extracted from line 284 (even fields) may include information regarding program content or information for controlling the operation of a video cassette recorder (VCR). In the case of VCR control information, signal SYSCTRL would be coupled to appropriate control points in

15 a VCR. The control unit 212 of the MPEG compressor 214 is programmed to recognize the decoded closed caption (or EDS) data, and to format it for inclusion in the compressed video signal headers.

FIGURE 4 illustrates exemplary receiver apparatus for

20 reproducing compressed video signal of the type generated by the FIGURE 2 circuitry. In FIGURE 4 transmitted compressed video signal is captured by an antenna and input to a modem 400. The modem provides baseband compressed video signal to an inverse transport processor 402. Within the inverse transport processor,

25 transport headers are separated from compressed video payloads (MPEG formatted signal) and the transport headers are communicated to the system controller 408 to provide system synchronization with the transmitter, and to provide information regarding damaged or lost data. The compressed video signal is

30 coupled to a decompressor such as a MPEG decoder 404. The MPEG decoder internally separates MPEG header data from compressed pixel data. The header data is utilized by the decoder to establish decompression parameters for decompressing the pixel data. The user data included in the compressed signal

35 headers is extracted by the decoder and provided to the system controller 408. The system controller 408 assembles words of the

closed caption data and provides them to a conventional on screen display device 406. Decompressed video signal is also applied to the on screen display device 406 wherein the closed caption data is superimposed on the video signal. The on screen display device

5 406 generates signals conditioned for application to a display element 410 for reproduction of the video images with the closed caption data superimposed thereon as text.

The FIGURE 4 apparatus is exemplary of a television receiver designed to decode and display compressed digital video

10 information. FIGURE 5 illustrates an embodiment contemplated for use in a set top receiver which receives signal in a format different than a standard format such as NTSC, and provides signal in a standard format such as NTSC. Output signal may be provided for application to the RF input of a standard receiver, or

15 as baseband component signals for application to an appropriate monitor.

In FIGURE 5, compressed video signal of the type generated by the FIGURE 2 apparatus is captured by an antenna an applied to a modem 500 which develops baseband compressed video

20 signal. The baseband compressed video signal is applied to an inverse transport processor 510, which provides system synchronization responsive to transport header information and separates the compressed video data for application to an e.g., MPEG decoder 520. The MPEG decoder 520 includes a data parser

25 524 which separates header data from compressed picture data. The header data is utilized to establish appropriate decompression parameters and configure the video decoder to decompress the compressed picture data. Frames of decompressed video signal are provided to, for example, an NTSC processor 540. Within the

30 processor 540, an NTSC encoder 541 renders decompressed frames into interlace fields. The interlace fields are coupled to an adder 544 wherein closed caption data from a further adder 543 is superimposed onto the video signal.

The original video signal may or may not have had the

35 closed caption or EDS signal stripped therefrom prior to compression. If it was not stripped prior to compression, it is

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necessary therefore to insure that the closed captioned data added into the decompressed signal via adder 544 is not corrupted by remnants of decompressed closed caption data. In view of this, adder 544 may be a non-additive mixer arranged to output the
5 closed caption signal provided by the adder 543, exclusive of the video signal provided by the encoder 541, whenever closed caption information is present.

The NTSC processor 540 also includes circuitry 5472 for generating appropriate color burst, horizontal and vertical
10 synchronization signals. These synchronizing components are added to the video signal at the adder 546. The output of the adder 546 is baseband composite NTSC signal including FCC standard closed caption data. This signal is applied to a modulator 550 which places the baseband video signal on a RF carrier having
15 a frequency associated with channel 3 or 4 for example.

Closed caption data transmitted as user data in MPEG picture headers is separated by the data parser 524 of the MPEG decoder 520. The closed caption data is coupled to a control unit 530 which conveys the respective closed caption data bytes, or closed
20 caption data bytes and EDS data bytes to the NTSC processor 540. These closed caption data bytes are stored in respective registers 542. A timing control unit 5473 develops read control signals at lines 21 (and 284 if EDS is present) to read the data bytes stored in the respective registers 542 for inclusion in lines 21 (and
25 possibly 284) of the decompressed interlaced video signal provided from the encoder 541.

A standard closed caption clock run-in signal with start bits is generated by a further element 5474. The run-in signal and the closed caption data are applied to an adder or non-additive
30 mixer 543 wherein they are sequentially concatenated to form a signal of the form illustrated in FIGURE 1 (minus burst and horizontal sync). This signal is applied to the adder 544 during line(s) 21(284).

Alternative receiver arrangements are indicated in both
35 FIGURES 4 and 5 by virtue of the phantom arrows drawn from the respective inverse transport processors to the respective control

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units. In both instances, the assumption is that the closed caption data is transmitted as part of the transport header or as auxiliary transport packets and not as part of the compressed video data. The closed caption data is separated in the transport processors

5 and thereafter processed by the respective control units as described above.

1 3

CLAIMS

1.   In system for compressing and transmitting a video signal which includes closed caption-like data, apparatus comprising:

5   a source (200) of video signal which includes closed caption-like data;

         circuitry (210) coupled to said source for extracting the closed caption-like data to produce digital data corresponding to said closed caption-like data;

1 0   compression apparatus (214) coupled to said source for compressing said video signal to generate a compressed digital video signal; and

         means (212) for separably combining said digital data corresponding to said closed caption data with compressed digital

1 5 video signal for transmission or storage.

2.   The apparatus set forth in claim 1 wherein said compression apparatus compresses video signal substantially according to MPEG protocol wherein compressed video signal

2 0 includes a picture layer including picture headers and said means for separably combining said digital data corresponding to said closed caption data with compressed digital video signal includes means to insert said digital data as user data in said picture headers.

3. The apparatus set forth in claim 1 wherein said compressed digital video signal includes a picture layer including picture headers, and said system further includes:

5   a transport processor for segmenting compressed video signal into transport packet payloads of predetermined size and for forming transport headers and error correction/detection codes related to respective segments and for concatenating said payloads, transport headers and said error correction/detection

10 codes to form transport packets; and

said means for separably combining said digital data corresponding to said closed caption data with compressed digital video signal includes means to insert said digital data in transport headers associated with transport packets containing said picture

15 headers.

4. The apparatus set forth in claim 1 wherein said system further includes:

a transport processor for segmenting compressed video

20 signal into transport packet payloads of predetermined size and for forming transport headers and error correction/detection codes related to respective segments and concatenating said payloads, transport headers and said error correction/detection codes to form transport packets, said transport processor further

25 including means for forming auxiliary transport packets for inclusion of auxiliary data; and

said means for separably combining said digital data corresponding to said closed caption data with compressed digital video signal includes means to insert said digital data in auxiliary

30 transport packets.

5. The apparatus set forth in claim 1 further including means for replacing said closed caption-like data in said video signal provided by said source with a reference value.

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6. In a system for receiving compressed video data including closed caption-like data which has not undergone compression, apparatus comprising:

means (524) for separating compressed video data from said
5 closed caption-like data;

means (522, 541) responsive to separated compressed video data for generating decompressed video signal;

closed caption encoding means (542-547) responsive to separated closed caption-like data and said decompressed video
10 signal for generating a baseband video signal including closed caption-like data.

7. The apparatus set forth in claim 6 further including a modulator coupled to receive said baseband video signal including
15 closed caption-like data for modulating said baseband video signal including closed caption-like data with an RF carrier.

8. The apparatus set forth in claim 6 wherein said closed caption encoding means includes:
20   means for storing respective separated closed caption data;

means for generating closed caption run-in signal;

means for concatenating closed caption data with said closed caption run-in signal;

means including timing means for detecting a
25 predetermined horizontal line of said decompressed video signal, and on detection of said predetermined horizontal line, substituting concatenated said closed caption data with said closed caption run-in signal for decompressed video signal in such horizontal line.

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9. In a system for receiving compressed video signal which has been compressed substantially according to MPEG protocol, said compressed video signal including a picture layer with

5   picture headers and said picture headers including closed caption data, apparatus comprising:

   means for providing said compressed video signal;

   means for separating said closed caption data from said compressed video signal;

10   means responsive to said compressed video signal for generating decompressed video signal;

   an on-screen display device responsive to separated closed caption data and said decompressed video signal for providing video image representative signal with closed caption text

15   superimposed thereon.

AMENDED CLAIMS
[received by the International Bureau on 08 November 1994 (08.11.94);
original claim 9 cancelled; original claims 6,7 and 8 amended
new claim 10 added; remaining claims unchanged (2 pages)]

　　　　　　　　6. In a system for receiving compressed video data

5　including closed caption-like data which has not undergone
compression, apparatus comprising:
　　　　　　　　means (524) for separating compressed video data
from said closed caption-like data;
　　　　　　　　means (522, 541) responsive to separated compressed

10　video data for generating decompressed video signal;
　　　　　　　　circuitry (406, 540) responsive to separated closed
caption-like data for combining information cantained in said
closed caption-like data with said decompressed video signal.

15　　　　　　　　7.　The apparatus set forth in claim 6, wherein said
circuitry includes an on-screen display device responsive to
separated closed caption-like data and said decompressed video
signal for providing video image representative signal with closed
caption text superimposed thereon.

20

　　　　　　　　8.　The apparatus set forth in claim 6 wherein said
circuitry includes:
　　　　　　　　means for storing respective separated closed caption
data;

25　　　　　　　　means for generating closed caption run-in signal;
　　　　　　　　means for concatenating closed caption data with said
closed caption run-in signal;
　　　　　　　　means including timing means for detecting a
predetermined horizontal line of said decompressed video signal,

30　and on detection of said predetermined horizontal line,
substituting concatenated said closed caption data with said closed
caption run-in signal for decompressed video signal in such
horizontal line to form a combined signal.

35

AMENDED SHEET (ARTICLE 19)

    10. The apparatus set forth in claim 8 further
including a modulator coupled to receive said combined signal for
5   modulating said combined signal with an RF carrier.

STATEMENT UNDER ARTICLE 19

Claims 6, 7 and 8 have been amended, Claim 9 cancelled and Claim 10 added to provide more appropriately worded claims and remove the issue of disunity.

Please acknowledge receipt of the above noted claim amendments and addition.
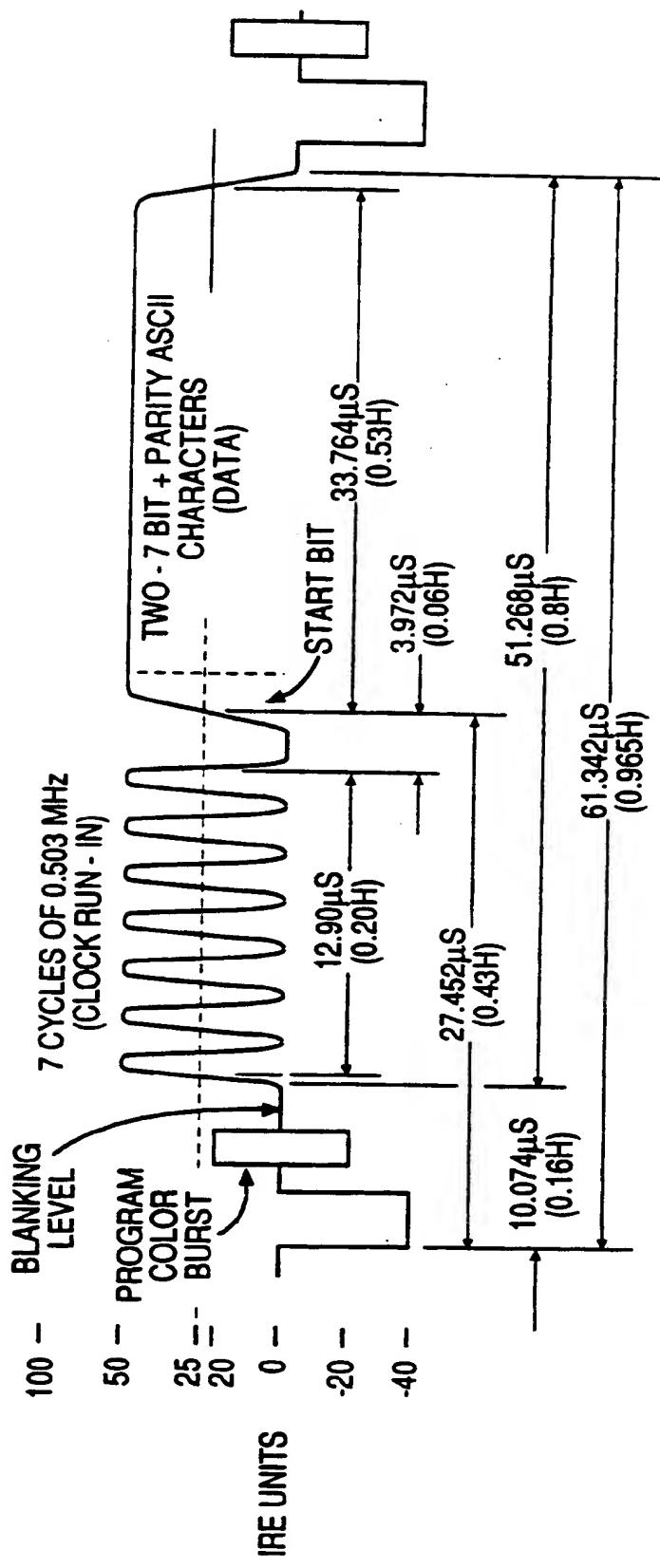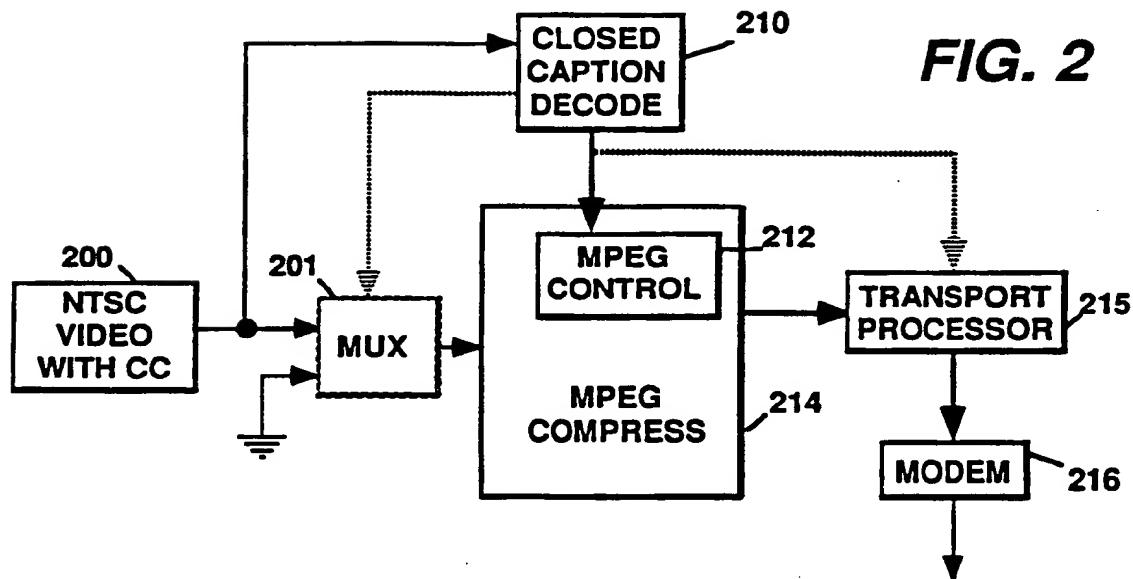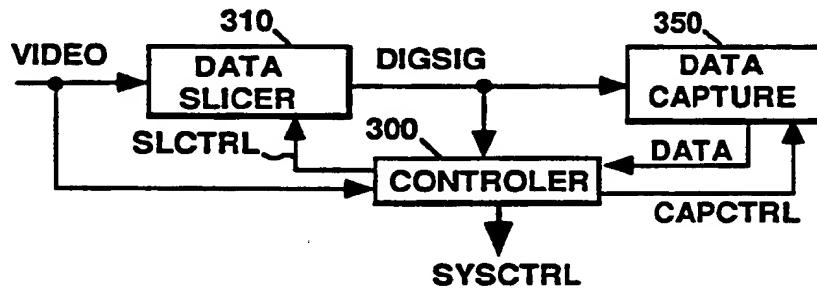
FIG. 1

FIG. 2

- **210** CLOSED CAPTION DECODE
- **200** NTSC VIDEO WITH CC
- **201** MUX
- **212** MPEG CONTROL
- **214** MPEG COMPRESS
- **215** TRANSPORT PROCESSOR
- **216** MODEM

FIG. 3

- VIDEO
- **310** DATA SLICER
- DIGSIG
- **350** DATA CAPTURE
- SLCTRL
- **300** CONTROLER
- DATA
- CAPCTRL
- SYSCTRL

FIG. 4

- **400** MODEM
- **402** INVERSE TRANSPORT PROCESS
- **404** MPEG DECODE
- **406** ON SCREEN DISPLAY
- USER DATA
- **408** SYSTEM CONTROL
- CONTROL DATA
- R　G　B
- **410** DISPLAY
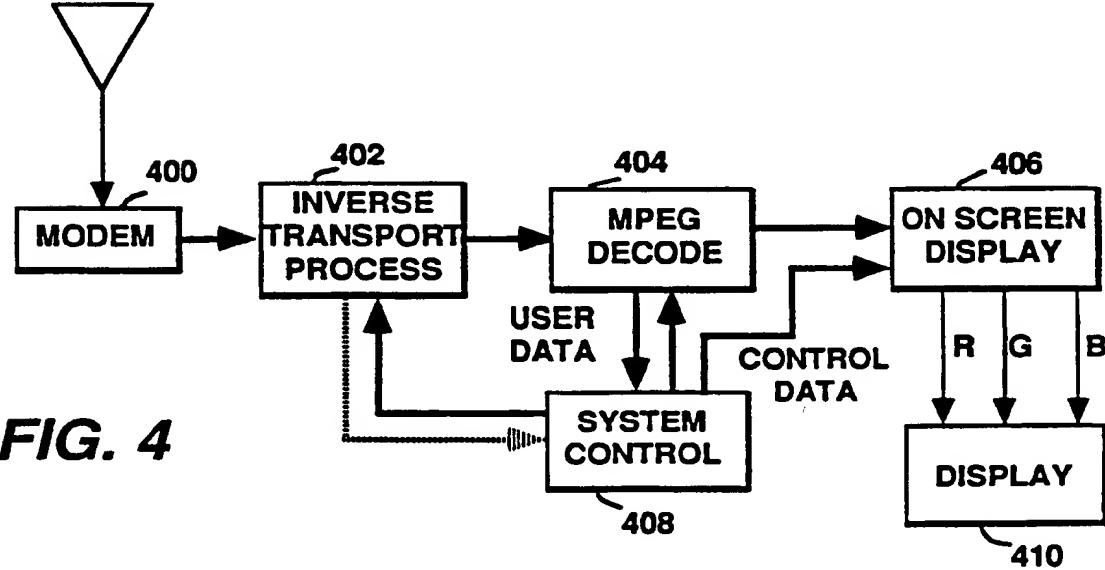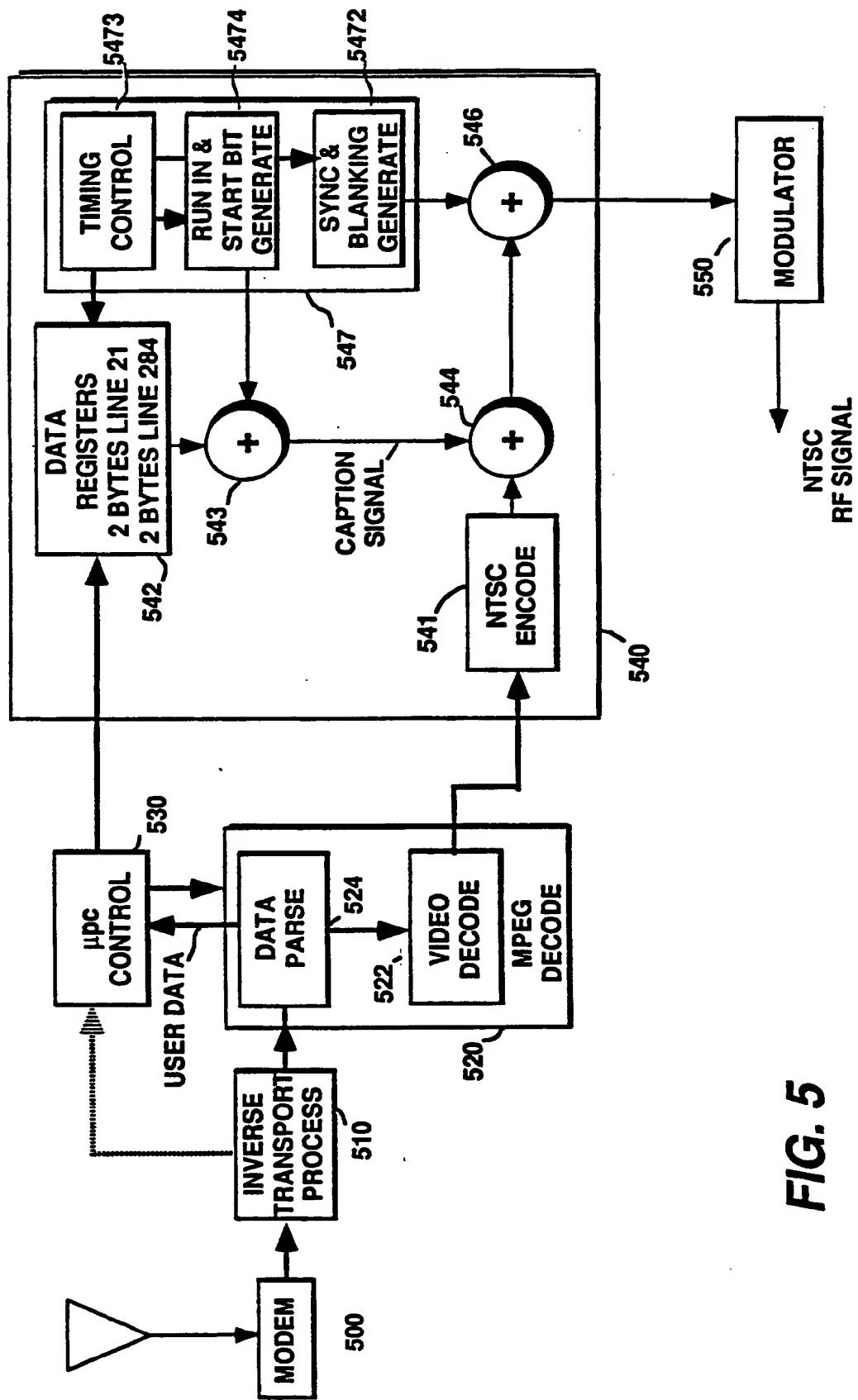
FIG. 5

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N7/08   H04N7/13

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,5 168 356 (ACAMPORA ET AL) 1 December 1992 cited in the application see column 3, line 12 - column 6, line 40 see column 11, line 19 - line 38; figures 1,2,3A,6	1,2,4,6, 9
A	ISO/IEC JTC 1/SC 29 N 147, 20 April 1992, TOKYO (JP) pages 78 - 85 'Coded Representation of Audio, Picture Multimedia and Hypermedia Information.' cited in the application see page 82; table 2.4.2.5	1,2,9

☐ Further documents are listed in the continuation of box C.   ☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 July 1994	0 9. 08. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Verleye, J

Form PCT/ISA/210 (second sheet) (July 1992)

Box I   Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II   Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

   1. claims 1-8: system for transmitting a video signal including caption-like data which are fed to a closed caption encoding means
   2. claim 9: system for transmitting a video signal including caption-like data which are fed to an on-screen display device

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1992)

Intc   .onal Application No

PCT/US 93/07827

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-5168356	01-12-92	CN-A-	1065568	21-10-92
		EP-A-	0501699	02-09-92
		JP-A-	5083685	02-04-93

NSDOCID: <WO___9506391A1_I_>

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